Coal Resources of Alaska

By FARRELL F. BARNES

CONTRIBUTIONS TO ECONOMIC GEOLOGY

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A summary of information concerning the quantity, quality, and distribution of coal

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ABSTRACT

The original coal resources of Alaska, as estimated in this report, total 130,125 million tons, including 19,429 million tons of bituminous coal and 110,696 million tons of subbituminous coal and lignite. These total-reserve estimates reflect a marked increase over previous estimates of about 22,000 million tons made in 1913, and about 96,000 million tons made in 1946. The present estimates cover seven areas, including northern Alaska, the Nenana, Jarvis Creek, and Broad Pass coal fields on the flanks of the Alaskan Range, and the Matanuska, Susitna, and Kenai fields in the Cook Inlet basin. The estimated resources consist of subbituminous coal and lignite in all areas except northern Alaska, where both bituminous and subbituminous coal are present, and the Matanuska field, where the reserves are bituminous coal. Not included in the estimates are several areas that may contain significant amounts of coal but for which data are insufficient for estimating resources. These include the Unga Island, Herendeen Bay, and Chignik coal fields in the Alaska Peninsula region, the Eagle field on the upper Yukon River, and the Bering River coal field in southeastern Alaska. Coal deposits of small or unknown extent occur at many other localities, particularly on the Seward Peninsula and along the Kobuk and lower Yukon Rivers.

The Alaskan coal industry grew rapidly during and immediately after World War II and leveled off after 1953 to an annual production fluctuating between 650,000 and 850,000 tons. Most of the production has come from the Nenana (subbituminous) and Matanuska (bituminous) coal fields. Prior to 1943 all coal mining in Alaska was done by underground methods, but by 1961 all mining was done by stripping. By the early 1960's competition from oil and gas, and to some extent from hydroelectric power, was forcing coal operators to search for ways to decrease the cost of production, such as the installation of mine-mouth powerplants to save the cost of transporting the coal. A possible future market for Alaskan coal is the development of a chemical industry utilizing as raw materials the large quantities of readily available low-rank coal, particularly in the Nenana, Susitna, and Kenai fields.

INTRODUCTION

This summary report on the coal resources of Alaska was prepared as part of a program of the U.S. Geological Survey to reappraise the coal resources of the Nation. Since virtually all the coal land of Alaska is in the public domain, the responsibility for appraising resources rests largely with Government agencies. The information on which this report is based was obtained largely from publications and records of the U.S. Geological Survey, from records of diamond drilling by the U.S. Bureau of Mines, and from mine maps and other records of mine operators.

Earlier estimates of the coal resources of Alaska include those made by Brooks (1909, p. 182) and later revised (Brooks and Martin, 1913, p. 552), and by Wahrhaftig in 1944 (in Buch and others, 1947, p. 235), later revised by Gates (1946, p. 8). (See table 1.) These early estimates were attempts to evaluate the total coal resources of the (then) Territory on the basis of existing information. As geologic knowledge of Alaska was, and still is, far from complete, and as none of the coal fields had been mapped in detail, these early estimates indicated only the general order of magnitude of the resources on a regional basis and were extensively revised as field investigations produced new information.

TABLE 1.—*Estimated original coal resources in Alaska*

[In millions of short tons]

After Brooks and Martin (1913)

Region	Lignite	Subbituminous	Bituminous	Semibituminous	Anthracite and semianthracite	Total
Pacific coast	2, 173	535	2	1, 425	2, 129	6, 264
Interior	10, 726	58	15			10, 799
Arctic slope	1, 003	3, 465		66		4, 534
Total	13, 902	4, 058	17	1, 491	2, 129	21, 597

After Gates (1946)

Region	Lignite and subbituminous	Bituminous	Anthracite	Total
Northern Alaska and Seward Peninsula	60, 000	22, 000		82, 000
Yukon Basin	5, 800	20		5, 820
Cook Inlet–Susitna	3, 000	1, 500	3	4, 503
Southwestern Alaska	600	100		700
Copper River–Alaska Gulf		1, 100	2, 100	3, 200
Southeastern Alaska	5			5
Total	69,405	24,720	2,103	96,228

Between 1943 and 1951 detailed geologic investigations were made of several of the more accessible coal fields, including the Nenana, Broad Pass, and Matanuska fields on The Alaska Railroad; the Jarvis Creek field near the Richardson Highway southeast of Fairbanks; and the Kenai field on the Sterling Highway south of Anchorage. On the basis of these investigations, in 1960 the writer prepared new estimates for each coal field (Barnes, 1961; and in Averitt, 1961, p. 46). The total resources in the new estimates are about the same as those shown in table 1 (after Gates, 1946). Since 1960 a detailed reconnaissance survey of the Susitna coal field (Beluga-Yentna region) has been completed (Barnes, 1966), and an evaluation of the coal resources of northern Alaska (Cape Lisburne–Colville River region) has been prepared from data obtained during petroleum investigations of Naval Petroleum Reserve No. 4 and adjacent areas in 1923–26 and 1944–53. The estimates presented in this report are therefore based on all data available prior to 1966. Still virtually unknown, however, except in a general way, are several areas, particularly in the Kobuk and Yukon River basins and on the Alaska Peninsula, in which significant deposits of coal probably occur.

The chief purpose of this report is to present coal-resource estimates based on the results of the latest investigations, and to classify the resources insofar as possible into the standard categories—based on rank, thickness of coal, depth of overburden, and relative abundance of reliable data—that have been adopted by the U.S. Geological Survey (Averitt, 1961, p. 12–26). A second purpose is to call attention to areas that are known to contain coal but for which data are insufficient for reliable estimates of resources. These areas need further investigation to determine which are favorable for prospecting and development.

METHODS OF PREPARING COAL-RESOURCE ESTIMATES

Any estimates of the coal resources of a large area are necessarily based on several assumptions as to thickness, extent, correlation of the coal beds, and other pertinent factors. This is especially true in Alaska, where the coal beds are largely concealed by surficial deposits, and information about them is confined to widely spaced outcrops, mines, prospects, and drill holes. In order to produce reasonably uniform results in preparing coal-resource estimates, the U.S. Geological Survey has adopted a set of definitions, procedures, and assumptions that was prepared jointly by members of the Geological Survey and the Bureau of Mines, and that includes recommendations of the former National Bituminous Coal Advisory Council (Averitt, 1961, p. 12–26). These definitions, procedures, and assumptions are discussed in the following paragraphs.

TABLE 2.—*Classification of coals by rank.*[1] *After American Society for Testing and Materials (1966)*

Class	Group	Fixed carbon limits, dry, mineral-matter-free basis (percent)		Volatile matter limits, dry, mineral-matter-free basis (percent)		Calorific value limits, moist,[2] mineral-matter-free basis (Btu per lb)		Agglomerating character
		Equal or greater than	Less than	Greater than	Equal or less than	Equal or greater than	Less than	
I. Anthracite	1. Meta-anthracite	98			2			
	2. Anthracite	92	98	2	8			
	3. Semianthracite	86	92	8	14			Nonagglomerating.[3]
II. Bituminous coal	1. Low volatile	78	86	14	22			
	2. Medium volatile	69	78	22	31			Commonly agglomerating.[5]
	3. High volatile *A*		69	31		[4] 14,000		Commonly agglomerating.[5]
	4. High volatile *B*					[4] 13,000	14,000	Commonly agglomerating.[5]
	5. High volatile *C*					11,500	13,000	Commonly agglomerating.[5]
						10,500	11,500	Agglomerating.
III. Subbituminous coal	1. *A*					10,500	11,500	Nonagglomerating.
	2. *B*					9,500	10,500	
	3. *C*					8,300	9,500	
IV. Lignite	1. *A*					6,300	8,300	
	2. *B*						6,300	

[1] This classification does not include a few coals, principally nonbanded varieties, which have unusual physical and chemical properties and which come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All these coals either contain less than 48 percent dry, mineral-matter-free fixed carbon or have more than 15,500 Btu per lb (moist, mineral-matter-free basis).

[2] Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

[3] If agglomerating, classify in low-volatile group of the bituminous class.

[4] Coals having 69 percent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of calorific value.

[5] It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and there are notable exceptions in high volatile *C* bituminous group.

CLASSIFICATION ACCORDING TO CHARACTERISTICS OF THE COAL

Rank of coal.—The standard classification of coals by rank used in the United States is that established by the American Society for Testing and Materials (1965). This classification, which is reproduced as table 2, is used uniformly in preparing coal-resource estimates. As coals of different ranks are adaptable to different uses, rank is the major basis of differentiation used in reporting resources.

Weight of coal.—The weight of coal in the ground varies with rank and with ash content. The following values, however, conform closely to the average of the recorded specific gravities of coal in each of the four major-rank categories:

Rank	Specific gravity	Tons per acre-foot	Tons per square mile-foot
Anthracite and semianthracite	1.47	2,000	1,280,000
Bituminous coal	1.32	1,800	1,152,000
Subbituminous coal	1.30	1,770	1,132,800
Lignite	1.29	1,750	1,120,000

Since few precise data on specific gravity of Alaskan coals are available, the above values for weight of coal in the ground were used in the present report. The resulting tonnage figures differ somewhat from those given in published reports of several Alaskan coal fields, which were based on a more conservative factor of 25 cubic feet per ton of coal, corresponding to a specific gravity of 1.28, or about 1,742 tons per acre-foot.

Thickness of coal beds.—According to the standard procedures of the U.S. Geological Survey, the following thickness categories of coal beds are used in calculating and reporting coal resources:

Rank		*Thickness categories*
Anthracite, semianthracite, and bituminous coal	inches	>42
		28–42
		14–28
Subbituminous coal and lignite	feet	>10
		5–10
		2½–5

These categories were used in classifying the resources given in this report, except that no coal beds less than 24 inches thick were included in the estimates of the bituminous coal resources of the Matanuska coal field.

The thickness of a coal bed should be evaluated wherever possible by the use of isopachs. This was done in parts of the Nenana coal field. Elsewhere in Alaska the data are insufficient for construction of isopachs, and average figures, weighted according to the approximate area of bed represented by each observation, were used. Where the points of observation were not evenly spaced, the weighting was done by assigning intermediate values for the thickness at places where data were needed to fill out a system of evenly spaced points. Where this procedure was followed to obtain the weighted average thickness along the outcrop of a persistent bed, the two end points of minimum thickness were also included in the average.

Partings more than three-eighths of an inch thick were omitted in determining the thickness of individual beds. Beds and parts of beds made up of alternating layers of thin coal and partings were omitted if the partings constituted more than half of the total thickness. Benches of coal of less than the stated minimum minable thickness, which lie above or below thick partings and which normally would be left in mining, were also omitted.

Areal extent of beds.—The areal extent of coal beds included in U.S. Geological Survey resource estimates is determined in several ways. Where the continuity of a bed is well established from maps of the outcrop, mine workings, and drill holes, the entire area of the known occurrrence of the bed is taken, even though points of observation are widely spaced. Persistent beds that have been traced around a basin or spur are considered to underlie the area enclosed by the outcrop. Otherwise, the length of outcrop between points of limiting thickness is considered to determine the presence of coal in a semicircular area whose radius is equal to half the length of the outcrop. The total area of coal is considered to extend beyond such a semicircle if mine workings or drill holes so indicate, but no more than 1 mile beyond the limiting point of information. An isolated drill hole too far removed to be incorporated in the area thus defined is considered to determine a circular area of coal with a maximum radius of half a mile around the hole.

The above-outlined procedure was used wherever practicable in computing the resource estimates given in this report; however, certain modifications were applied in some areas. For example, the outcrop length of many of the gently dipping beds exposed in the Homer district beach bluffs of the Kenai coal field is determined, not by thinning, but by abrupt termination where the coal dips below beach deposits at the foot of the bluff, and where it is truncated by glacial deposits near the top of the bluff. Such beds were assumed to underlie a rectangular area extending back from the outcrop a distance equal to half the length of the outcrop or, if the outcrop is less than a mile in length, half a mile. Coal beds in Alaskan coal fields are commonly exposed at a single point, generally in a stream valley, and their continuations are concealed by glacial or other surficial deposits. Such outcrops are assumed to establish continuity for half a mile in all directions, except where termination at a shorter distance is indicated by geologic evidence. Other modifications of the standard procedure are noted in the descriptions of individual coal fields.

Thickness of overburden.—Following standard practice the resource data were reported wherever possible in the following three categories according to thickness of overburden in feet: 0–1,000, 1,000–2,000, and 2,000–3,000. In many of the Alaskan coal fields the estimated resources all lie within 1,000 feet of the surface; only in the northern Alaska and Nenana fields were resources calculated in all three depth categories. Although about half of the coal in the Wishbone Hill district of the Matanuska field probably lies under more than 1,000 feet of overburden, the relatively steep dips, high relief, and scarcity of subsurface data made it impracticable to separate the tonnage estimates into depth categories. No coal more than 3,000 feet below the surface was included in the estimates.

CLASSIFICATION ACCORDING TO RELATIVE ABUNDANCE OF INFORMATION

Wherever possible, coal-resource estimates reported by the U.S. Geological Survey are divided into three categories according to the relative abundance and reliability of data used in preparing the estimates. These classes are termed "measured," "indicated," and "inferred."

Measured resources.—Measured resources are those for which tonnage is computed from dimensions revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of the coal are so well defined that the computed tonnage is judged to be accurate within 20 percent of the true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of coal varies in different regions according to the character of the coal beds, the points are, in general, about half a mile apart.

Indicated resources.—Indicated resources are those for which tonnage is computed partly from specific measurements and partly from projection of visible data for a reasonable distance on geologic evidence. In general, the points of observation are approximately 1 mile apart, but the spacing may be somewhat greater for beds of known continuity.

Inferred resources.—Inferred resources are those for which quantitative estimates are based on broad knowledge of the geologic character of the bed or region and for which few measurements of bed thickness are available. The estimates are based on assumed continuity for which there is geologic evidence. In general, inferred coal lies more than 2 miles from the outcrop or from points of mining or drill-hole information.

In some of the Alaskan coal fields local conditions, such as complex structure and lack of persistence of coal beds, made necessary a much closer spacing of points of observation to establish continuity than is indicated in the preceding paragraphs. For example, where lenticular beds were traced across areas known to include several small faults, observations no more than a few hundred feet apart were necessary for positive identification. In only a few areas were data sufficient to warrant classification of resources as "measured," and in two areas, the Homer district of the Kenai coal field and the Beluga-Yentna region of the Susitna coal field, no attempt was made to calculate resources in the "inferred" category, for reasons given in the detailed discussions of those fields.

DISTINCTION BETWEEN ORIGINAL, REMAINING, AND RECOVERABLE RESOURCES

The coal resources of a region may be considered from three different points of view, depending on whether the appraiser is concerned with the amount of coal originally in the ground, the amount remaining as of the date of appraisal, or the amount that can be expected to be recovered by future mining.

Original resources.—Original resources are those in the ground prior to mining. The original resources of the parts of Alaska for which data are available total 130,125 million short tons. Estimates for individual coal fields, classified insofar as possible into the categories described in the preceding section, are presented in tables 4 and 5.

Remaining resources.—Remaining resources are those in the ground as of the date of appraisal and may be determined by subtracting past production and mining losses from the original resources. As little or no coal has been produced from many of the Alaskan coal fields, the original and remaining resources in these fields are virtually the same. According to official records of the Geological Survey, the total reported coal production through 1964 was about 16.4 million tons. Data on losses in mining are available for only one small area, the Wishbone Hill district of the Matanuska coal field, where the amount of coal represented by mined-out areas in 1952 was equal to approximately twice the reported production to that date, indicating a mining loss of 50 percent. This figure agrees with the general average for mines in the United States (Averitt, 1961, p. 23–26) and is the figure generally assumed for large areas for which more detailed information is not available. On this basis, the amount of coal mined and lost in mining in

Alaska to the end of 1964 totals twice the reported production, or about 33 million tons. This figure, subtracted from the estimated original resources of 130,125 million tons, leaves 130,092 million tons as the amount of coal remaining as of January 1, 1965.

Recoverable resources.—Recoverable resources represent the quantity of coal in the ground as of the date of appraisal that is considered to be recoverable by mining. As recoverability varies greatly with several factors, including the character of the beds being mined and the methods employed in mining, it is difficult to assign an average figure. On the assumption that the 50-percent mining loss indicated in the Wishbone Hill district is applicable to Alaska coal mining in general, the recoverable resources, as of January 1, 1965, are equal to half the remaining resources, or 65,046 million tons. It should be noted, however, that because of the complete conversion from underground to strip mining in Alaska, and because recoverability in strip mining tends to run as high as 90 percent (Averitt, 1961, p. 25), the rate of recovery of Alaskan coal currently may be considerably higher than the 50-percent figure, which is based largely on the results of underground mining. In the long view, however, since only a relatively small percentage of the total estimated resources is considered to be strippable, a 50-percent recoverability factor for all coal probably is justified.

SUMMARY OF ALASKAN COAL RESOURCES

The original coal resources in the parts of Alaska for which data are available are estimated at 130,125 million tons, distributed as shown in table 3. Because of insufficient data no estimates are given for many parts of Alaska that are known to contain significant amounts of coal. These include the Yukon River, along which beds

TABLE 3.—*Estimated coal resources of Alaska*

[In millions of short tons]

Coal field	Original resources		
	Bituminous	Subbituminous and lignite	Total
Northern Alaska	*19, 292*	*100, 905*	*120, 197*
Nenana		6, 938	6, 938
Jarvis Creek		76	76
Broad Pass		64	64
Matanuska	137		137
Susitna		2, 395	2, 395
Kenai (Homer district)		318	318
Total	19, 429	110, 696	130, 125

of minable thickness are exposed at several points; the Alaska Peninsula, containing three little-known coal fields of considerable extent; the Bering River field, which contains many beds of high-rank coal but is so structurally complex that it may not be possible to mine much coal economically; and many other smaller areas. Furthermore, the figures given in table 3 are known to be incomplete for several of the areas listed, as indicated in the descriptions of individual coal fields in the following section. For example, the figure given for the Homer district of the Kenai field represents less than 100 square miles of the 750-square mile area probably underlain by coal-bearing rocks, and those for the northern Alaska and Susitna coal fields include only the coal within specified distances of widely spaced outcrops, separated by much larger areas that are probably coal bearing. Additional fieldwork and subsurface information are needed before the total coal resources of these incompletely known areas can be adequately evaluated.

COAL FIELDS OF ALASKA

Coal deposits are widely distributed in many parts of Alaska (pl. 1), mainly in Cretaceous and Tertiary rocks. At two places small, probably unimportant deposits occur in rocks of late Paleozoic age.

The principal coal fields of the State occur in five major areas: (1) northern Alaska, including several extensive but inadequately known coal fields on the Arctic Slope north of the Brooks Range; (2) central Alaska, including the important Nenana coal field on the north flank of the Alaska Range and scattered occurrences of coal-bearing rocks along the Yukon River and some of its major tributaries, on the Kobuk River, and on the Seward Peninsula; (3) the Cook Inlet–Susitna region, including the Broad Pass, Susitna, Matanuska, and Kenai coal fields; (4) the Alaska Peninsula, including the Herendeen Bay, Unga Island, and Chignik coal fields; and (5) southeastern Alaska, including the Bering River coal field and several minor coal localities to the southeast on the mainland and on islands of the Alexander Archipelago.

Each of the Alaskan coal fields is briefly described on the following pages; the reader will find more detailed information in the publications listed at the end of this report. Detailed estimates of original resources of bituminous coal and of subbituminous coal and lignite are given in tables 4 and 5. Analyses of most of the samples of Alaskan coals taken prior to April 1, 1945, were published by the U.S. Bureau of Mines (Cooper and others, 1946). Analyses of representative coals are summarized in table 6.

TABLE 4.—*Estimated original resources of bituminous coal in Alaska*

(In millions of short tons)

Coal field and district	Overburden (feet)	Measured resources: Bed thickness (inches) 14–28	28–42	>42	Total	Indicated resources: Bed thickness (inches) 14–28	28–42	>42	Total	Inferred resources: Bed thickness (inches) 14–28	28–42	>42	Total	Total resources: Bed thickness (inches) 14–28	28–42	>42	Total
Northern Alaska:																	
Corwin Bluff-Cape Beaufort district	0–1,000					25.1	9.0	21.9	56.0	119.6	88.9	78.8	287.3	144.7	47.9	100.7	293.3
	1,000–2,000									158.4	62.5	106.9	317.8	158.4	52.5	106.9	317.8
	2,000–3,000									183.0	61.9	126.3	371.2	183.0	61.9	126.3	371.2
Kukpowruk River	0–1,000					31.2	75.7	140.6	247.5	351.0	276.4	820.6	1,448.5	382.8	352.1	961.1	1,696.0
	1,000–2,000									100.9	118.2	435.8	654.9	100.9	118.2	435.8	654.9
	2,000–3,000									126.1	139.6	448.7	714.4	126.1	139.6	448.7	714.4
Kokolik River	0–1,000					10.4	10.8	77.7	98.9	71.9	184.2	663.3	919.4	82.3	195.0	741.0	1,018.3
	1,000–2,000									90.5		513.6	604.1	90.5		513.6	604.1
	2,000–3,000									106.9		606.8	713.7	106.9		606.8	713.7
Utukok River	0–1,000					12.8	8.5	69.5	90.8	409.9	54.9	1,055.0	1,519.8	422.7	63.4	1,124.5	1,610.6
	1,000–2,000									34.8	69.7	409.3	513.8	34.8	69.7	409.3	513.8
	2,000–3,000									41.2	82.3	490.0	613.5	41.2	82.3	490.0	613.5
Meade River	0–1,000					6.1	12.1	84.4	102.6	62.7		1,128.0	1,190.7	68.8	12.1	1,212.4	1,293.3
	1,000–2,000									75.7		682.6	758.3	75.7		682.6	758.3
	2,000–3,000									89.5		807.2	896.7	89.5		807.2	896.7
Colville River	0–1,000					71.2	121.6	49.4	242.2	1,561.8	1,829.5	427.1	3,818.4	1,633.0	1,951.1	476.5	4,060.6
	1,000–2,000									327.6	783.2	503.3	1,614.1	327.6	783.2	503.3	1,614.1
	2,000–3,000									361.7	711.5	474.4	1,547.6	361.7	711.5	474.4	1,547.6
Total	0–1,000					156.8	237.7	443.5	838.0	2,577.5	2,383.9	4,172.7	9,134.1	2,734.3	2,621.6	4,616.2	9,972.1
	1,000–2,000									787.9	1,023.6	2,651.5	4,463.0	787.9	1,023.6	2,651.5	4,463.0
	2,000–3,000									908.4	995.3	2,953.4	4,857.1	908.4	995.3	2,953.4	4,857.1
Total northern Alaska						156.8	237.7	443.5	838.0	4,273.8	4,402.8	9,777.6	18,454.2	4,430.6	4,640.5	10,221.1	19,292.2
Matanuska coal field:																	
Wishbone Hill	0–2,000	0.1	0.7	5.8	6.6	1.2	9.5	41.0	51.7		10.0	43.7	53.7	1.3	20.2	90.5	112.0
Chickaloon	0–2,000							.7	.7			24.3	24.3			25.0	25.0
Total Matanuska	0–2,000	0.1	0.7	5.8	6.6	1.2	9.5	41.7	52.4		10.0	68.0	78.0	1.3	20.2	115.5	137.0
Total Alaska	0–1,000					156.8	237.7	443.5	838.0	2,577.5	2,383.9	4,172.7	9,134.1	2,734.3	2,621.6	4,616.2	9,972.1
	1,000–2,000									787.9	1,023.6	2,651.5	4,463.0	787.9	1,023.6	2,651.5	4,463.0
	2,000–3,000									908.4	995.3	2,953.4	4,857.1	908.4	995.3	2,953.4	4,857.1
	0–2,000	0.1	0.7	5.8	6.6	1.2	9.5	41.7	52.4		10.0	68.0	78.0	1.3	20.2	115.5	137.0
Grand total		0.1	0.7	5.8	6.6	158.0	247.2	485.2	890.4	4,273.8	4,412.8	9,845.6	18,532.2	4,431.9	4,660.7	10,336.6	19,429.2

TABLE 5.—*Estimated original resources of subbituminous coal and lignite in Alaska*

[In millions of short tons]

Coal field and district	Overburden (feet)	Measured resources				Indicated resources				Inferred resources				Total resources			
		Bed thickness (feet)			Total	Bed thickness (feet)			Total	Bed thickness (feet)			Total	Bed thickness (feet)			Total
		2½–5	5–10	>10		2½–5	5–10	>10		2½–5	5–10	>10		2½–5	5–10	>10	
Northern Alaska:																	
Utukok River	0–1,000					8.2	40.6	21.2	70.0	41.2	223.7	725.8	990.7	40.4	204.3	747.0	1,060.7
	1,000–2,000									54.3	81.7		136.0	54.3	81.7		136.0
	2,000–3,000									64.1	96.5		160.6	64.1	96.5		160.6
Kaolak Test Well 1	0–3,000					29.8		71.0	100.8	2,400.0	14,980.1	25,900.0	43,280.0	2,429.8	14,980.0	25,971.0	43,380.8
Kuk River (Wainwright)	0–1,000					15.6	20.8	26.2	62.6	496.1		899.0	1,395.1	511.7	20.8	925.2	1,457.7
Kugrua River (Peard Bay)	0–1,000						44.2		44.2		796.0		796.0		840.2		840.2
Meade River	0–1,000					160.0	34.5		194.5	5,063.8	1,098.0		6,161.8	5,223.8	1,132.5		6,356.3
Meade Test Well 1	0–3,000					14.2	120.8	462.0	597.0	1,010.0	8,319.0	23,474.0	32,803.0	1,024.2	8,439.8	23,936.0	33,400.0
Ikpikpuk River	0–1,000					28.9	14.7	36.8	80.4	751.0	138.0		889.0	779.9	152.7	36.8	969.4
	1,000–2,000									361.0	153.0		514.0	361.0	153.0		514.0
	2,000–3,000									59.5	117.0		176.5	59.5	117.0		176.5
Titaluk Test Well 1	0–3,000					17.0			17.0	947.0			947.0	964.0			964.0
Colville River	0–1,000					166.2	265.3		431.5	2,724.5	4,285.2		7,009.7	2,890.7	4,550.5		7,441.2
	1,000–2,000									794.5	1,024.0	1,920.0	3,738.5	794.5	1,024.0	1,920.0	3,738.5
	2,000–3,000									106.9			106.9	106.9			106.9
Umiat Test Well 11	0–3,000					11.4			11.4	191.1			191.1	202.5			202.5
Total	0–1,000					378.9	420.1	84.2	883.2	9,076.6	6,540.9	1,624.8	17,242.3	9,455.5	6,961.0	1,709.0	18,125.5
	1,000–2,000									1,209.8	1,258.7	1,920.0	4,388.5	1,209.8	1,258.7	1,920.0	4,388.5
	2,000–3,000									230.5	213.5		444.0	230.5	213.5		444.0
	0–3,000					72.4	120.8	533.0	726.2	4,548.1	23,299.0	40,374.0	77,221.1	4,620.5	23,419.8	40,907.0	77,947.8
Total northern Alaska						451.3	540.9	617.2	1,609.4	15,065.0	31,312.1	52,918.8	99,295.9	15,516.3	31,853.0	53,536.0	100,905.3
Nenana coal field:																	
Rex Creek	0–1,000						9.5		9.5	23.0	79.8	10.7	113.5	23.0	89.3	10.7	123.0
Tatlanika Creek	0–1,000						4.0	113.4	117.4	31.2	8.9	37.0	77.1	31.2	12.9	150.4	194.5
	1,000–2,000										2.4	74.0	76.4		2.4	74.0	76.4
Wood River	0–1,000		15.0		15.0		12.0		12.0		201.0	40.0	241.0		228.0	40.0	268.0
	1,000–2,000						15.0		15.0						15.0		15.0
	2,000–3,000						18.0		18.0						18.0		18.0

California Creek	0-1,000		4.0	2.0	6.0		27.0	206.6	233.6	12.3	50.6	317.0	379.9	12.3	81.6	525.6	619.5
	1,000-2,000						1.0	6.0	7.0		11.0	121.0	132.0		12.0	127.0	139.0
Lignite Creek	0-1,000		16.0	250.6	266.6		93.0	1,326.0	1,419.0	29.0	279.3	1,043.0	1,351.3	29.0	388.3	2,619.6	3,036.9
	1,000-2,000						7.0	458.0	465.0	3.0	52.0	226.0	281.0	3.0	59.0	684.0	746.0
	2,000-3,000											327.0	327.0			327.0	327.0
Healy Creek	0-1,000			300.0	300.0		1.0	93.5	94.5		27.0	114.2	141.2		28.0	507.7	535.7
	1,000-2,000			274.0	274.0		1.0	63.0	64.0		21.0	112.4	133.4		22.0	449.4	471.4
	2,000-3,000							245.0	245.0		23.0	87.8	110.8		23.0	332.8	355.8
Savage River	0-1,000										12.0		12.0		12.0		12.0
Total	0-1,000		35.0	552.6	587.6		146.5	1,739.5	1,886.0	95.5	658.6	1,561.9	2,316.0	95.5	840.1	3,854.0	4,789.6
	1,000-2,000			274.0	274.0		24.0	527.0	551.0	3.0	86.4	533.4	622.8	3.0	110.4	1,334.4	1,447.8
	2,000-3,000						18.0	245.0	263.0		23.0	414.8	437.8		41.0	659.8	700.8
Total Nenana field			35.0	826.6	861.6		188.5	2,511.5	2,700.0	98.5	768.0	2,510.1	3,376.6	98.5	991.5	5,848.2	6,938.2
Jarvis Creek coal field	0-1,000					0.8	5.1		5.9	45.0			45.0	45.8	5.1		50.9
	1,000-2,000									25.6			25.6	25.6			25.6
Total Jarvis Creek field						0.8	5.1		5.9	70.6			70.6	71.4	5.1		76.5
Broad Pass coal field:																	
Broad Pass	0-1,000						0.3		0.3		63.3		63.3		63.6		63.6
Costello Creek	0-1,000					0.3			.3					0.3			.3
Total Broad Pass field						0.3	0.3		0.6		63.3		63.3	0.3	63.6		63.9
Susitna coal field:																	
Yentna River	0-1,000					19.4	8.6	27.9	55.9					19.4	8.6	27.9	55.9
Skwentna River	0-1,000					6.6	2.5	113.9	123.0					6.6	2.5	113.9	123.0
Beluga River	0-1,000					17.4	44.6	198.1	260.1					17.4	44.6	198.1	260.1
Capps Glacier district	0-1,000						8.9	396.9	405.8						8.9	396.9	405.8
Chuitna River	0-1,000					16.3	25.5	1,498.7	1,540.5					16.3	25.5	1,498.7	1,540.5
Beach southwest of Tyonek	0-1,000					3.1	6.3		9.4					3.1	6.3		9.4
Total Susitna field						62.8	96.4	2,235.5	2,394.7					62.8	96.4	2,235.5	2,394.7
Kenai coal field (Homer district)	0-1,000					264.2	54.0		318.2					264.2	54.0		318.2
Total Alaska	0-1,000		35.0	552.6	587.6	707.0	722.4	4,059.2	5,488.6	9,217.1	7,262.8	3,186.7	19,666.6	9,924.1	8,020.2	7,798.5	25,742.8
	1,000-2,000			274.0	274.0		24.0	527.0	551.0	1,238.4	1,345.1	2,453.4	5,036.9	1,238.4	1,369.1	3,254.4	5,861.9
	2,000-3,000						18.0	245.0	263.0	230.5	236.5	414.8	881.8	230.5	254.5	659.8	1,144.8
	0-3,000					72.4	120.8	533.0	726.2	4,548.1	23,299.0	49,374.0	77,221.1	4,620.5	23,419.8	49,907.0	77,947.3
Grand total			35.0	826.6	861.6	779.4	885.2	5,364.2	7,028.8	15,234.1	32,143.4	55,428.9	102,806.4	16,013.5	33,063.6	61,619.7	110,696.8

TABLE 6.—*Range in composition and heating value of representative Alaskan coals*

[On "as received" basis]

Location	Source of samples	Rank of coal	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Heating value (Btu)
			Percent					
Northern Alaska Region:								
Corwin Bluff-Cape Beaufort district	Outcrop	Bituminous	3.0- 5.9	28.8-40.1	47.8-58.0	4.1-11.6		
Kukpowruk River	do	do	0.8- 9.9	31.4-35.6	52.6-56.1	2.5-15.0	0.2- .3	11,910-12,880
Kokolik and Utukok Rivers	do	do	1.7- 8.2	33.1-37.4	46.8-57.9	2.3-17.4	.2- .6	11,630-13,840
Kuk and Kugrua Rivers	do	Subbituminous	17.8-26.7	29.1-31.9	40.5-42.6	2.3- 9.8	.2- .3	8,780- 9,510
Meade and Ikpikpuk Rivers	Mine	do	14.4	33.5	47.3	4.8	.6	10,330
	Outcrop	do	8.3- 9.9	32.4-36.5	37.7-49.9	6.4-20.0	.2- .8	7,700-10,720
	do	Bituminous	3.4	36.5	46.8	13.3	.7	11,660
Colville River	do	do	2.5- 6.6	30.1-48.7	39.3-62.8	2.6-24.8	.3- .7	10,430-13,450
	do	Subbituminous	5.2-16.4	28.8-31.6	41.9-49.2	11.8-23.4	.3- .7	8,460- 9,390
Central Alaska Region:								
Kobuk River	do	Bituminous	10.5	29.0	52.9	7.6	.4	10,534
Koyukuk River (Tramway Bar)	do	do	4.5	34.2	48.3	12.9		
Chicago Creek (Seward Peninsula)	Mine dump	Lignite	33.8	39.9	19.2	7.1		6,825
Ruby-Anvik district (Yukon River)	Mine	Bituminous	1.0-11.2	24.8-40.5	49.9-65.0	3.5-22.6	.2- .6	
Rampart district (Drew mine)	do	do	9.5	40.1	37.4	13.0		
Eagle-Circle district:								
Washington Creek	Outcrop	Subbituminous(?)	11.1-13.5	42.6-48.7	39.7-44.2	2.1- 3.1	.2- .3	
Nation River	Mine dump	Bituminous	1.4	40.0	55.6	3.0	3.0	
Nenana coal field	Mine	Subbituminous	17.8-27.1	33.2-42.0	27.1-35.3	3.5-13.2	.1- .3	7,570- 9,430
	Outcrop	do	11.7-32.7	31.2-42.9	22.7-36.6	3.3-16.9	.1- .4	6,320-10,385
Jarvis Creek coal field	do	do	20.0-23.0	35.1-43.4	24.1-35.3	5.2-13.1	.3-1.4	7,815- 9,415

Cook Inlet-Susitna Region:								
Broad Pass coal field:								
Costello Creek district	Mine	do	8.7-18.8	32.0-43.4	23.2-42.2	6.0-21.2	.3- .6	7,985-10,800
Broad Pass district	Tunnel and trench	Lignite	21.8-35.8	27.8-34.5	20.7-28.3	10.6-21.0	.2- .3	5,410- 7,040
Susitna coal field	Outcrop	Subbituminous	19.7-28.2	30.1-39.9	28.7-40.6	2.0-14.2	.1- .4	8,080- 9,520
	do	Lignite	31.6-33.1	32.9-37.6	26.4-29.1	2.1- 7.6	.1- .3	7,030- 8,020
Beluga Lake district	Drill hole	Subbituminous	11.3-19.3	27.8-37.9	25.8-34.6	13.3-30.5		6,290- 8,890
	Trench	do	24.4	30.1	28.7	16.8	.2	7,160
Matanuska coal field:								
Little Susitna district	Mine	do	17.4-20.3	31.6-32.5	36.6-38.9	9.2-13.5	.4	9,160- 9,210
	Outcrop	do	14.1	31.3	34.1	20.5	.4	8,460
Wishbone Hill district	Mine	Bituminous	2.7- 8.6	31.6-44.6	38.4-51.0	4.4-21.7	.2-1.0	10,390-13,190
Chickaloon district	do	do	1.1- 4.1	13.8-22.9	59.1-72.2	5.8-19.5	.4- .7	11,960-14,380
Anthracite Ridge district	Outcrop	do	1.9- 6.8	14.3-31.6	47.4-78.4	2.4-17.2	.5- .7	11,300-14,210
	do	Semianthracite	3.1- 8.7	6.6-10.5	64.8-80.6	7.0-21.0	.2- .7	10,720-13,425
Kenai coal field (Homer district)	do	Subbituminous	21.2-27.7	31.2-38.1	24.1-38.7	8.2-22.0	.2- .4	6,550- 8,600
	do	Lignite	27.1-30.4	31.8-41.3	24.5-30.3	3.9-15.7	.1- .2	6,640- 7,540
	Mine	Subbituminous	16.5-21.6	30.3-38.1	31.2-41.1	9.1-12.1	.3- .4	8,380- 9,020
Alaska Peninsula Region:								
Herendeen Bay coal field	Tunnel	Bituminous	7.5- 8.0	32.1-33.5	48.8-51.4	7.1-11.6	.3- .4	11,280-11,790
	Outcrop	do	4.2- 6.7	35.2-38.6	47.2-53.0	5.0-12.0	.4- .6	11,150-12,420
Unga Island coal field	do	Lignite	23.3	25.4	25.1	26.2	.5	5,810
Chignik coal field	Mine or prospect	Bituminous	5.0-10.8	27.2-34.3	39.6-45.4	14.9-25.3	.7-2.3	9,640-11,240
Southeastern Alaska Region:								
Bering River coal field	Mine	do	1.0- 8.6	13.1-17.4	65.0-91.1	2.1-18.0	.6-3.4	11,000-16,000
	do	Semianthracite	2.9- 6.0	10.8-13.0	60.8-76.1	4.9-22.2	.6-4.9	12,350
	Outcrop	Bituminous	1.5- 7.7	10.9-15.4	58.1-81.7	1.2-25.4	.7-1.4	10,440-14,860
	do	Semianthracite	1.6- 9.4	8.7-18.6	60.9-84.7	1.7-24.8	.5-4.1	9,880-15,020
	do	Anthracite	3.0- 8.3	6.0-13.3	66.0-82.5	2.1-20.5	.6-2.9	11,890-12,790
Kootznahoo Inlet (Admiralty Island)	Mine	Bituminous	3.8- 6.4	34.3-35.2	36.3-39.6	21.4-23.0	.9-1.3	9,930-10,630

NORTHERN ALASKA

The principal coal-bearing districts of northern Alaska lie north of the Brooks Range and west of the Itkillik and lower Colville Rivers (pl. 1). The southern part of this area consists of a broad upland dissected into rolling hills, north of which the nearly flat Arctic Coastal Plain extends to the Arctic Ocean. Coal-bearing Cretaceous rocks are known or inferred to underlie about 58,000 square miles of this area. These rocks, consisting mainly of alternating layers of sandstone and shale, have been folded into eastward-trending anticlines and synclines. Because of differences in resistance of the rocks to erosion, the folds are expressed topographically by the general east-west alinement of the ridges and valleys. Near the mountains the folding and faulting has been more intense and in places the strata stand nearly vertical, but in the northern foothills, which include the southernmost coal-bearing rocks, deformation has been only moderate, and farther north under the Coastal Plain the beds are nearly horizontal.

East of the Itkillik and lower Colville Rivers a few scattered coal beds have been reported in Cretaceous rocks, and several possibly extensive areas are underlain by lignite-bearing Tertiary rocks. Far to the west, along the coast south of Cape Lisburne, bituminous coal is exposed in several places in strongly folded and faulted Mississippian rocks. Since little is known of the nature and extent of the coal deposits in these two regions no resource estimates were made.

The following descriptions of the principal coal districts are based on several published reports on different parts of northern Alaska (Chapman and Sable, 1960; Chapman and others, 1964; Detterman and others, 1963; Keller and others, 1961). Estimated resources for each district, prepared from these reports and supplemental unpublished data by F. F. Barnes, are given in tables 4 and 5. In computing coal resources in northern Alaska, it was assumed that the known great areal extent of the several coal-bearing units, plus the almost universal presence of potentially valuable coal beds in such units, justified the use, in determining the extent of individual coal beds, of broader limits than were used in other parts of Alaska, where the coal-bearing units are known to be of much smaller extent and the individual beds are characteristically lenticular. Accordingly, in computing tonnages, indicated coal was assumed to extend 1 mile rather than half a mile, and inferred coal 6 miles, from outcrops or drill holes, except where shown by geologic evidence to terminate at a shorter distance. Representative analyses of coals in each district are given in table 6.

Corwin Bluff-Cape Beaufort district.—At least 20 beds of bituminous coal ranging from 2½ to 9 feet in thickness, as well as many thinner beds, are exposed in beach bluffs from the vicinity of Corwin

Bluff, about 30 miles east of Cape Lisburne, to Cape Beaufort. These beds dip moderately to steeply southwestward from the eastward-trending coast, and one inland outcrop shows that the coal-bearing rocks extend at least 10 miles along the strike.

Kukpowruk River district.—Coal-bearing rocks are exposed at intervals along the lower 25 miles of the Kukpowruk River, where they lie in a series of eastward-trending folds which dip 12°–55°. Forty coal beds 1½–13 feet thick were measured along the river; some of the beds may be repeated by folding. Coal-bearing rocks also underlie a small area 70 miles above the mouth of the river and include at least one 3-foot bed of coal. Analyses show all this coal to be of bituminous rank. Because these beds are exposed only in the river valley, their lateral extent is unknown, but geologic evidence suggests that large areas on both sides of the river may be underlain by coal beds of minable thickness.

Kokolik-Utukok Rivers district.—Coal beds ranging from 2 to 6 feet in thickness are exposed at several points along the Kokolik River near the northern edge of the foothills belt. The beds have been slightly to moderately folded, and the coal is probably all of bituminous rank. Coal is exposed at intervals along the Utukok River between points 25 and 80 miles above its mouth in beds ranging from a few inches to nearly 12 feet in thickness. These beds also have been slightly to moderately folded, but the coal appears to decrease in rank northward, from bituminous in the foothills to subbituminous on the Coastal Plain.

Kuk-Kugrua Rivers district.—Beds of subbituminous coal, ranging from 3 to 14½ feet in thickness, crop out at several points along the Kuk and Kugrua Rivers near the Arctic coast south and east of Wainwright. These beds are all nearly horizontal, and some of them reportedly have been traced for several miles along the east shore of the Kuk estuary (Smith and Mertie, 1930, p. 308), so they may closely underlie many square miles of the surrounding Coastal Plain.

Farther inland a test well near the Kaolak River, a principal head water tributary of the Kuk, disclosed a thick coal-bearing section, including 36 coal beds ranging from 3 to 26 feet in thickness, within 3,000 feet of the surface. Geophysical evidence indicates that the well is near the axis of a broad anticline with gently dipping limbs (Collins, 1958, p. 353). Although no fresh samples from this well were analyzed, the coal is probably of subbituminous rank because in northern Alaska coal-bearing rocks that are more intensely folded generally contain bituminous coal.

Meade-Ikpikpuk Rivers district.—The Mead and Ikpikpuk Rivers both head in the northern foothills belt and flow northward across the

Coastal Plain to the Arctic Ocean. Coal of probable bituminous rank is exposed at several localities near the head of the Meade River, in beds ranging from 2 to 6 feet in thickness. Farther downstream subbituminous coal, in beds mostly less than 5 feet thick, crops out at several localities between points 25 and 100 miles from the mouth of the river. At one point a small strip mine has been operated to supply fuel for the village of Barrow. A test well a few miles west of the river near the southern edge of the Coastal Plain cuts a coal-bearing section that includes 21 coal beds 4–30 feet thick, within 2,000 feet of the surface. This coal also lies in a broad anticline and is considered to be of subbituminous rank.

Subbituminous coal is exposed at several places along the Ikpikpuk River on the Coastal Plain, but all the known beds are too thin to be of value. On the Kigalik River, a headwater tributary of the Ikpikpuk in the foothills belt, several beds of subbituminous coal 2½–5 feet thick are exposed, and two beds of comparable thickness were found in a test well just east of the upper Ikpikpuk River.

Colville River district.—In the Colville River district, including the basin of the Colville River and its many large tributaries, coal is widely distributed both in the foothills and on the Coastal Plain. Subbituminous coal occurs in the eastern part of the district, principally in the Prince Creek Formation of Late Cretaceous age, in beds that are mostly less than 5 feet thick but include a few that are 10 feet thick. Bituminous coal crops out at many points along the northeast-trending segment of the Colville River and its southern tributaries, in the Chandler Formation of Cretaceous age. The beds range in thickness from a few inches to 8 feet, but many of them are less than 3 feet thick. The subbituminous coals south of the Colville River generally occur in broad synclinal basins with low dips; those west of the north-flowing segment of the Colville River are nearly horizontal. The bituminous coal is restricted to the moderately folded rocks of the foothills belt.

CENTRAL ALASKA

The area here defined as the central Alaska region is south of the Brooks Range and north of the Alaska Range. It lies mainly within the Yukon River basin but also includes the Kobuk and Kuskokwim River basins, the Seward Peninsula, and intervening areas with coastal drainage. Coal-bearing rocks are widely distributed throughout the region, but only in the Nenana coal field, along the north flank of the Alaska Range, do they contain coal deposits of known commercial importance. Elsewhere coal has been found only in isolated outcrops, many of which have been developed to a small extent as local sources of fuel. At only a few places outside of the Nenana coal field have attempts been made to develop a commercial mine.

The known coal deposits of the region, with one minor exception, are all early Tertiary or Late Cretaceous. Some of those on the lower Yukon were at one time considered to be Tertiary, but later studies showed that most, if not all, of the deposits are in Cretaceous rocks (W. W. Patton, oral commun., 1956). The only extensive deposits that are unquestionably Tertiary are in the Nenana coal field; those along the south side of the Yukon River between Eagle and Circle probably are also Tertiary, although conflicting interpretations of paleobotanical data leave the possibility that Cretaceous beds may be included (Mertie, 1942, p. 237–241). A single small occurrence on the Nation River just above its junction with the Yukon is in late Paleozoic rocks.

Kobuk River.—Coal-bearing rocks that are probably Late Cretaceous occur at several widely scattered localities in a belt that extends along the Kobuk River and eastward to the headwaters of the Koyukuk River. The westernmost locality is on the north side of the Kobuk between Trinity Creek and the Kallarichuk River, where several thin coal beds, only a few of which are as much as 2 feet thick, are exposed in the river bluffs (Smith and Mertie, 1930, p. 319–320). Some of this coal was mined for use in nearby placer-gold fields. An analysis of a sample from this locality indicates that it is on the borderline between subbituminous and bituminous coal (table 6). Other reported coal localities in the Kobuk basin are on the Hunt, lower Ambler, and Kogoluktuk Rivers, and in the Lockwood Hills near the Pah River.

A noteworthy coal occurrence that apparently lies within an eastward extension of the coal-bearing rocks of the Kobuk basin has been reported at Tramway Bar, on the Middle Fork of the Koyukuk River about 35 miles above Bettles (Smith and Mertie, 1930, p. 316). At this point F. C. Schrader in 1899 reported a coal bed containing 9–10 feet of nearly pure coal. An analysis of this coal indicates that it probably is bituminous in rank (table 6). As far as is known, this coal has not been developed; its extent is unknown. The presence of coal on the John River, north of Bettles, is indicated by abundant coal float in the river gravels, but no coal has been found in place.

Seward Peninsula.—Small areas of coal-bearing rocks, probably all of Late Cretaceous age, have been reported in the valleys of the Sinuk, Koyuk, and Kugruk Rivers on the Seward Peninsula. Significant coal deposits are known only on the Kugruk River, about 15 miles west of Candle, where coal beds have been opened on the river about 4 miles south of Chicago Creek, and on Chicago Creek about a mile above its mouth (Henshaw, 1909, p. 362–364; Toenges and Jolley, 1947, p. 3–5).

The bed on the river is reported to contain 18 feet of lignitic coal in three benches separated by several inches of clay. This bed dips nearly 70° and has been opened by a slope from which a few thousand tons of coal has been mined. The bed on Chicago Creek also has been opened by a slope, from which 60,000–100,000 tons of lignite was mined between 1908 and 1911 (Toenges and Jolley, 1947, p. 4). This bed, which dips 53° and has only a few thin partings, is reported to be at least 85 feet thick where measured along a crosscut (Henshaw, 1909, p. 363). The coal is frozen solid down to the bottom of the slope, 200 feet vertically below the surface. The only information on the extent of the bed was obtained by drilling in 1908, which showed that the coal is present about 70 feet below the surface half a mile northwest of the mine.

Unalakleet district.—Lignitic coal is known at two localities near Unalakleet. One is on the shore of Norton Sound about 10 miles south of the village, and the other is on the Unalakleet River about 40 miles above its mouth. The exposure south of Unalakleet is reported to contain at least one coal bed 4–8 feet thick, in shale of probable Tertiary age (W. W. Patton, oral commun., 1966). A small amount of coal has been taken from this locality. No details are known of the coal at the river locality.

Ruby-Anvik district.—Coal occurs at several localities on the north and west bank of the Yukon River between Ruby and Anvik (Collier, 1903, p. 46–58), in the Kaltag Formation of Late Cretaceous age. The approximate locations and known coal thickness at the principal exposures are as follows: 20 miles above Galena, 1 foot; 10 miles above Nulato (Pickart mine), 1½–3 feet; 1 mile above Nulato, 6 inches; 4 miles below Nulato (Bush mine), probably less than 2 feet; 9 miles below Nulato (Blatchford mine), thickness unknown, sheared pockets 8 feet across; 50 miles below Kaltag (Williams mine), 3¼ feet; and 16 miles above Blackburn (Coal Mine No. 1), 2½–3 feet. The coal at all these localities is bituminous in rank and for the most part was used as a satisfactory fuel for river steamboats. The only localities where conditions are favorable for appreciable resources are the Williams and No. 1 mines, from each of which several hundred tons of coal was mined prior to 1903.

Coal-bearing rocks have been reported on the Anvik River about 100 miles above its mouth, at a point about 35 airline miles west of the Yukon (Harrington, 1918, p. 65). Harrington reported that the deposits include one 10-foot bed and several 2-foot beds of coal. Nothing is known of their quality, structure, or extent. Coal has also been reported in the vicinities of Poorman and Flat south of the Yukon. The coal near Poorman is subbituminous; that near Flat is unusual—

the chemical properties are those of anthracite but the appearance is that of subbituminous coal (Smith, 1915, p. 269–270). These deposits are probably Cretaceous and are apparently of small extent (Mertie and Harrington, 1924, p. 119).

Kuskokwim district.—Coal-bearing rocks have been reported at several localities in this district, including one of the Cheeneetnuk River, a tributary of the Swift River, in the Kuskokwim River basin, and three on Nelson and Nunivak Islands, west of Bethel. At the river locality, Tertiary coal-bearing rocks are exposed at intervals for several miles along the stream, where they apparently have been downthrown against older rocks in a major fault zone (W. H. Condon, oral commun., 1965). One exposure includes a 6-foot bed of bright brittle coal that is probably of bituminous rank. The coal at two localities on Nelson Island is of probable Cretaceous age and of bituminous rank, but it is in beds less than 2 feet thick and has a high ash content (Coonrad, 1957). Coal in beds about 2 feet thick is reported to occur on the north shore of Nunivak Island about 10 miles southwest of Cape Etolin (J. M. Hoare, oral commun., 1965). The site was covered by ice when visited by Geological Survey personnel in 1965, so no samples or accurate measurements were obtained.

Rampart district.—Coal-bearing rocks are exposed for several miles along the south and east bank of the Yukon River in the vicinity of Rampart, on the west bank of the Yukon opposite Hess Creek, and on Coal Creek, a tributary of the Dall River about 70 miles above its junction with the Yukon (Collier, 1903, p. 36–43). The rocks at all these localities were originally tentatively correlated with the Kenai Formation of Tertiary age on the basis of lithologic similarity or plant fossils, but more detailed study may show that these rocks, like similar ones in other parts of central Alaska, are of Late Cretaceous age.

Although several coal beds were reported near Rampart, apparently none of them are of sufficient thickness or quality to have warranted development. The best known coal locality in this district is at the Drew mine, opposite Hess Creek, where at least 1,000 tons of bituminous coal was mined prior to 1902 for use on river steamers. The mine was opened on a 19-foot coaly section containing only 3 feet of coal in two thin benches. The section at this locality is reported to contain six other coal beds, all dipping steeply to the southeast, but as far as is known none of them was opened for measuring and sampling. A test pit on the first bed below the mine bed exposed 4–7 feet of crushed coal. The known strike length of these beds is small, as the coal-bearing rocks are exposed only in a 4-square mile area in a bend of the river.

The coal on the Dall River is exposed at only one point, in the bed of Coal Creek about a mile above its mouth, where an 11-foot bed contains 4–5 feet of bright clean coal similar to that near Rampart.

Eagle-Circle district.—Coal-bearing rocks, probably of early Tertiary age, underlie a belt ranging from 2 to 10 miles in width that extends from the Canadian border just south of the Yukon River northwestward for about 80 miles to the vicinity of Woodchopper Creek (Brabb and Churkin, 1964). Coal has been reported at several localities in this belt; in the basin of Mission Creek, west of Eagle; on the Seventymile River; on Washington Creek, which enters the Yukon from the south above the Charley River; on Bonanza Creek, an eastern tributary of the Charley River; and on Coal Creek, which enters the Yukon from the south below the Charley River (Collier, 1903, p. 26–33). Because all available analyses are many years old, it is difficult to determine the rank according to present methods of classification, but most, if not all, of the coal in this belt is probably subbituminous in rank. Little is known of the extent of any of the individual deposits, and the only ones that appear to have been explored to any great degree are those on Washington Creek. Sections measured on this creek include at least 5 coal beds containing 4 feet or more of clean coal, as well as several thinner beds, which are compressed into broad open folds and dip less than 45°. No underground work is known to have been done on these beds.

A deposit of coal that differs in quality, and possibly in age, from that just described occurs on the Nation River near its junction with the Yukon (Collier, 1903, p. 33–36). The coal appears to be in the Nation River Formation of Paleozoic age and is reported to be a bituminous coking coal. About 2,000 tons was mined and used on river steamers before mining difficulties forced abandonment of the mine. The coal apparently lies in a fault zone, and the enclosing beds, which dip 40° SE. at the surface, are overturned and dip northwestward in the mine. The coal bed is not well defined, as the coal occurs in large pockets and kidneys resulting from intense crushing and shearing.

Another coal deposit worth mention, although it lies about 50 miles south of the Eagle-Circle district proper, is at Chicken, on a small tributary of the South Fork of the Fortymile River (Mertie, 1930, p. 141–142). There a bed of subbituminous coal was opened by a 35-foot shaft and found to be at least 22 feet thick, although neither the top nor the bottom was exposed. The bed is vertical and was followed underground for only 60 feet, so its lateral extent is not known. The mine was caved and abandoned when visited by the writer in 1956. The coal-bearing rocks at this locality, which probably underlie only a few square miles, have been assigned a Tertiary age on the basis of lithology.

Nenana coal field.—The Nenana coal field, one of the two producing coal fields of Alaska, extends for about 80 miles along the north flank of the Alaska Range, between the headwaters of the Wood River on the east and the Kantishna River on the west. Tertiary coal-bearing rocks crop out in a discontinuous belt generally ranging from 1 to 30 miles in width. The rocks have been folded and faulted into a series of basins, between which they are either eroded away or covered by younger Tertiary or Quaternary deposits. The coal-bearing formations include a large number of subbituminous coal beds, ranging from a few inches to 60 feet in thickness. Summaries of analyses of mine and outcrop samples from the Nenana field are given in table 6. Resource figures based on a detailed survey of this field by Wahrhaftig are given in table 5.

The structure of most of the individual basins is simple; the beds are broken by a few faults and compressed into open folds with moderate to low dips. At the east end of the Healy Creek basin nearly vertical to slightly overturned beds were measured near the axis of a faulted syncline.

The Nenana coal field is served by The Alaska Railroad, which follows the Nenana River across the center of the field. Principal development and coal production to date has been on Healy Creek (Wahrhaftig and others, 1951) and from an underground mine at Suntrana and two strip mines farther upstream. A strip mine was operated for a few years during and after World War II on the western extension of the same beds about 4 miles southwest of Healy, and a strip mine was opened in 1955 on Lignite Creek. All other parts of the field are remote from present transportation and are undeveloped.

Jarvis Creek coal field.—The Jarvis Creek coal field lies at the foot of the north flank of the Alaska Range a few miles east of the Delta River. Although geologically it is an eastern extension of the Nenana coal field, geographically it is quite distinct. It is about 16 square miles in area, and the coal-bearing rocks, of Tertiary age, dip 5°–10° around the border of a structural basin. Measured sections include 30 coal beds ranging from 1 foot to 7 feet in thickness, but only a few are more than 2½ feet thick. Analyses show the coal to be subbituminous *C* in rank and relatively high in ash (table 6).

Estimated resources based on a detailed survey (Wahrhaftig and Hickcox, 1955) are given in table 5. A few hundred tons has been produced from one small mine opened in 1958.

COOK INLET–SUSITNA REGION

The Cook Inlet–Susitna region of south-central Alaska includes the Broad Pass, Susitna, Matanuska, and Kenai Tertiary coal fields. The coal of the Broad Pass, Susitna, and Kenai fields is subbituminous and lignite; that of the Matanuska field ranges from subbituminous to anthracite, but most of it is bituminous.

Broad Pass coal field.—The Broad Pass field lies just south of the Divide of the Alaska Range, on the headwaters of the Chulitna River. Coal is known chiefly in two districts, one near Broad Pass Station on The Alaska Railroad (Hopkins, 1951) and the other on Costello Creek (Wahrhaftig, 1944; Rutledge, 1948), a northern tributary of the West Fork of the Chulitna, about 11 miles by truck road from the railroad at Colorado Station. The coal on Costello Creek is classed as subbituminous and that near Broad Pass Station as lignite. Analyses of several samples from each of the two districts are summarized in table 6. Although the mapped area of coal-bearing rocks is only 7 square miles on Costello Creek and 1½ square miles near Broad Pass Station, the total area underlain by these rocks probably is much larger, as suggested by the presence of coal outcrops at points farther south on the Chulitna River.

Coal resources on Costello Creek were estimated in 1943 to include 350,000 tons of indicated coal, but most of the remaining coal has since been removed or lost by underground and strip mining. Total reported production, in the period 1940–54, was about 64,000 tons. Resources in the mapped part of the Broad Pass district were estimated in 1944 to be at least 13 million tons; much larger tonnages probably exist in adjoining unmapped areas.

Susitna coal field.—The Susitna coal field is here defined as the coal-bearing part of the extensive lowland that lies north of Cook Inlet, between the Talkeetna Mountains on the east and the Alaska Range on the north and west. The coal is in the Kenai Formation, of Tertiary age. Although coal-bearing rocks are exposed only in scattered small areas, mainly along the larger streams, their distribution and attitude indicate that they probably underlie at least 3,400 square miles of the lowland beneath a mantle of glacial and alluvial deposits. A study of all coal exposures (Barnes, 1966) determined that most of the potentially valuable coal deposits lie in a 400-square-mile area at the southern end of the field, in the basins of the Beluga and Chuitna Rivers. The beds are relatively flat or gently folded, except locally along a few major faults. This field is completely undeveloped and virtually without roads; however, some of the best deposits are close to tidewater.

A large but undetermined number of beds of subbituminous coal and lignite, ranging from a few inches to more than 50 feet in thickness, are exposed in the Beluga-Chuitna area. A nearly horizontal bed of lignite 30–50 feet thick was traced for more than 7 miles along the middle course of the Chuitna River, and a similar bed about 50 feet thick extends for about 4 miles along the escarpment south of the toe of Capps Glacier. Other thick beds crop out on the Beluga River, on the Skwentna River and its southern tributary Canyon Creek, and near Fairview Mountain in the Yentna River basin. Table 6 summarizes analyses of 15 outcrop samples from various parts of the field and 44 core samples and 1 trench sample taken by the U.S. Bureau of Mines 3 miles east of Beluga Lake.

Estimates of indicated coal resources in the Susitna field are given in table 5. No estimates of inferred resources were made because of the general lack of evidence of continuity of coal beds beneath covered areas. As the estimates include only coal within half a mile of measured outcrops, the total potential resources of the field may be several times larger than shown.

Matanuska coal field.—The Matanuska coal field, which occupies much of the Matanuska Valley, includes several areas of coal-bearing rocks in a belt extending from a point near the head of the valley proper westward to the Susitna River valley. Although the coal of this field is all Tertiary, it increases in rank progressively eastward, from subbituminous coal in the Little Susitna district to anthracite in the Anthracite Ridge district. The western part of the field, including the Little Susitna and Wishbone Hill districts, is served by The Alaska Railroad, but the eastern part is reached only by the Glenn Highway, which passes along the southern edge of the Chickaloon and Anthracite Ridge districts.

The Little Susitna district lies at the western end of the coal field between the Little Susitna River and the southern front of the Talkeetna Mountains. Although subbituminous coal occurs at several points in the district, the beds are generally too thin or impure to be considered minable (Barnes and Sokol, 1959, p. 138). A strip mine was operated for several years near Houston, but the recoverable coal is largely mined out and the mine is closed.

The Wishbone Hill district (Barnes and Payne, 1956) is on the north side of the Matanuska Valley about 10 miles northeast of Palmer. The coal-bearing Chickaloon Formation of early Tertiary age underlies an area of about 15 square miles between Moose and Granite Creeks. The structure of the district is dominated by a northeastward-trending syncline, with moderately dipping limbs, which is broken by several transverse faults. The coal occurs in a large number of beds ranging from a few inches to 23 feet in thickness and is high-volatile bituminous in rank. Analyses of coal samples from mines in this district are summarized in table 6.

Estimated resources based on detailed surveys of the Wishbone Hill district are given in table 4. In computing tonnages, structurally complex areas on the south limb of the syncline and in the easternmost part of the district were excluded from consideration because of scarce data. In some areas it was necessary to compute tonnages for groups of beds rather than individual beds, because of uncertainties in correlation. For the same reasons, indicated resources were assumed to extend only 2,000 feet from points of observation, rather than to the 1-mile limit generally applied in larger areas of more uniform beds.

The Chickaloon district (Capps, 1927, p. 73–90) as here defined includes an area of about 12 square miles around the old mining camp of Chickaloon, on the Chickaloon River about a mile above its mouth. The district is about 30 highway miles northeast of Palmer. Although the coal-bearing Chickaloon Formation has been mapped in a much larger area, the district as defined includes most of the known coal beds of potential economic value, as determined by extensive surface mapping and subsurface exploration. The principal deposits are at Chickaloon, north of the Matanuska River, and on Coal Creek, south of the river.

The structure of the district is dominantly synclinal, but belts of tight folding and crumpling are locally superposed on the syncline. The structure is further complicated by many faults, including a few of large displacement. In addition, the coal-bearing rocks have been invaded by many intrusive masses, mainly in the form of dikes and sills.

The coal is low-volatile bituminous in rank, and some may be of coking quality. Analyses of 29 samples from the Chickaloon district are summarized in table 6. The coal occurs in a large number of lenticular beds ranging from a few inches to 14 feet in thickness. Because of intense squeezing and crushing and the presence of many faults, crumpled belts, and dikes and sills, the coal is difficult and expensive to mine and consequently has not been developed commercially. Although minable blocks of coal may be present in other parts of the district, estimates for only the relatively undisturbed area immediately north of Chickaloon are included in table 4.

The Anthracite Ridge district (Waring, 1936) lies at the eastern end of the Matanuska coal field, about 12 miles east of Chickaloon. The Glenn Highway crosses its southern margin. The district is about 30 square miles in area and extends from the south slope of Anthracite Ridge southward to the Matanuska River. As in the Chickaloon district, the coal-bearing Chickaloon Formation has been invaded by many intrusive masses, mainly in the form of sills, ranging from a few inches to many hundreds of feet in thickness. The structure of most of the district is characterized by broad open folds, but along the northern margin the rocks that form the front of Anthracite

Ridge have been compressed into tight, locally overturned folds and are broken by several high-angle faults.

The coal in this district ranges in rank from anthracite and semi-anthracite in the intensely deformed northern part to bituminous in the southern part. Analyses of 23 samples from the district are summarized in table 6. At two exposures coal beds 34 and 24 feet thick were measured, and several beds contain between 5 and 10 feet of coal, but most beds are considerably thinner and all tend to pinch out or grade into shale within short distances.

Although several million tons of coal, possibly including a million tons of anthracite, probably is present in the Anthracite Ridge district, the irregular thickness, complex structure, and presence of intrusive masses has effectively discouraged development. As it is doubtful that much if any of the coal is present in minable bodies, no attempt has been made to make detailed resource estimates.

Kenai coal field.—The Kenai coal field lies on the west side of the Kenai Peninsula, on the lowland between the Kenai Mountains and Cook Inlet. The coal-bearing Kenai Formation of Tertiary age is exposed at many points in the southern part of the lowland, referred to as the Homer district. In the northern part, or Kenai district, bedrock is completely concealed by glacial and alluvial deposits, but the presence of the Kenai Formation was originally inferred from the fact that similar rock are exposed to the north and west across Cook Inlet. This inference was confirmed when several thousand feet of coal-bearing rocks was penetrated in oil wells in the Swanson River area. Available evidence indicates that the surficial deposits are at least several hundred feet thick throughout this district, so any valuable coal deposits that may be present are probably not economically recoverable under present conditions.

The Homer district (Barnes and Cobb, 1959), which includes the part of the Kenai lowland south of Tustumena Lake, is 1,100 square miles in area and includes the type locality of the Kenai Formation. Beds exposed along the shores of Cook Inlet and Kachemak Bay include at least 5,000 feet of nonmarine sandstone, siltstone, claystone, and coal. They outline a broad structural basin or trough locally modified by gentle folds and by high-angle faults with displacements ranging from a few inches to 80 feet. Included in the exposed section are at least 30 coal beds ranging from 3 to 7 feet in thickness, as well as many thinner beds. Exposures are largely limited to coastal bluffs and the banks of the larger streams.

The coal ranges in rank from lignite to subbituminous *B*, but the greater part is subbituminous *C*. Analyses of 16 outcrop samples and 4 mine samples from the Homer district are summarized in table 6.

Although mining has been attempted in the vicinity of Homer from time to time since 1888, the total production of the field does not exceed a few thousand tons. Estimated coal resources in the Homer district are given in table 5. These estimates include only coal in the indicated category, largely lying within half a mile of the coast. Larger resources are undoubtedly present farther inland, but because of the scarcity of outcrops and the marked lenticularity of the coal beds, no attempt was made to compute tonnages in the inferred category.

ALASKA PENINSULA

Coal is present in significant amounts in three coal fields on the Alaska Peninsula—the Herendeen Bay, Unga Island, and Chignik fields. The Unga Island field contains only Tertiary lignite; the other two fields contain both Cretaceous bituminous coal and Tertiary lignite.

Herendeen Bay coal field.—Coal-bearing rocks of the Chignik Formation of Late Cretaceous age underlie at least 40 square miles on the peninsula between Herendeen Bay and Port Moller (Atwood, 1911, p. 96–108). These bays indent the north shore of the Alaska Peninsula about 350 miles southwest of Kodiak. The beds are moderately folded and are broken by several small faults. A fault having a throw of at least 1,000 feet marks the southern margin of the field. Most of the coal, which is bituminous in rank, occurs in a large number of rather closely spaced beds ranging from a few inches to 7 feet in thickness. Analyses of two samples from tunnels and nine from outcrops are summarized in table 6. Little is known of the extent or continuity of individual beds, and consequently no reliable estimates of resources are possible.

Tertiary lignite-bearing beds extend over several hundred square miles, particularly to the south and east of Herendeen Bay. Although these beds have not been extensively explored, available information indicates that few, if any, of the lignite beds are of possible economic value.

Some development work was done in the bituminous coal of this field between 1880 and 1902, but no commercial production was attained. Although the field is readily accessible to tidewater, Herendeen Bay is blocked by ice for several months each year. Past plans for development have included the construction of 15 miles of railroad through a low pass to Balboa Bay, on the Pacific Ocean side of the peninsula, which reportedly provides a good ice-free harbor.

Unga Island coal field.—Tertiary lignite-bearing rocks underlie an area of about 40 square miles in the northwestern part of Unga Island, off the south coast of the Alaska Peninsula opposite Herendeen Bay

(Atwood, 1911, p. 117–120). A section measured in the beach bluff on the west shore of Coal Harbor (Zachary Bay) includes nearly 300 feet of poorly cemented sand, clay, and gravel, interbedded with which are five beds of lignite ranging from a few inches to 4 feet in thickness. These beds dip uniformly 8°–10° W. and are overlain conformably by 200 feet of conglomerate. The one available analysis indicates that the heating value of the lignite is rather low and its ash content is high (table 6).

Several tunnels have been opened in these deposits, and one mine was placed on a shipping basis about 1911, but no large production resulted.

Chignik coal field.—The Chignik coal field (Atwood, 1911, p. 108–117) is on the west shore of Chignik Bay, which indents the southeast shore of the Alaska Peninsula about 250 miles southwest of Kodiak. It includes the fishing village of Chignik. Coal-bearing rocks of the Chignik Formation, of Late Cretaceous age, are confined largely to a northeastward-trending belt about 25 miles long and 1–3 miles wide along the northwest shore of Chignik Bay. Some development of coal deposits has been done at four localities in the belt, but none of the beds have been traced more than short distances. The coal is bituminous in rank, and beds ranging from 1 to 5 feet in thickness have been measured, although most of them contain less than 3 feet of coal. All are rather high in ash. Analyses of four samples from mines and prospects in the Chignik field are summarized in table 6. The details of the structure are not known, but the beds appear to have been only moderately folded, having dips of 21°–34°. The coal at one locality is cut by at least three vertical faults.

Shipment of coal from this field probably would require construction of a road through a low pass to the head of Kuiukta Bay, about 5 miles south of the southwest end of the coal belt, because Chignik Bay itself offers no suitable harbor facilities. Data available are insufficient for reliable resource estimates.

SOUTHEASTERN ALASKA

Southeastern Alaska as here defined includes a narrow coastal belt extending from the mouth of the Copper River near Cordova eastward to Yakutat Bay, as well as the so-called panhandle to the southeast generally referred to as southeastern Alaska. The most extensive coal deposits in this area are in the Bering River coal field, 50 miles east of Cordova; and on Kootznahoo Inlet, on the west side of Admiralty Island. Coal-bearing rocks also occur near Icy and Yakutat Bays and at several localities farther southeast, including Murder Cove at the southern tip of Admiralty Island, Kasaan Bay on Prince of

Wales Island, Hamilton Bay on Kupreanof Island, and Port Camden on Kuiu Island (Buddington and Chapin, 1929, p. 353). At most, if not all, of these localities the coal is lignitic, of small extent, and apparently of little value. It is all of Tertiary age.

Bering River coal field.—Coal-bearing rocks have been mapped in an almost continuous belt, about 50 square miles in total area, that extends northeastward from the east shore of Bering Lake for about 20 miles, to where the rocks disappear under the ice fields of the Chugach Range (Martin, 1908, pl. 8). The coal probably all lies in the Kushtaka Formation, a dominantly arkosic Tertiary sequence.

The structure of this field is complex. The beds in most of the area are tightly folded, locally overturned, and cut by many faults, including several thrust faults of large displacement. The intensity of the deformation increases to the northeast.

The coal ranges in rank from low-volatile bituminous in the southwestern part of the field to semianthracite and anthracite in the eastern part. Analyses of a large number of samples taken from tunnels and outcrops in many parts of the field are summarized in table 6. Available information indicates that at least part of the bituminous coal is of coking quality. The coal occurs in a large but undetermined number of beds that show marked changes in thickness within short distances. Measured thicknesses range from a few inches to 60 feet. In many of the beds thickening has resulted from intense structural deformation. Almost everywhere the coal is strongly crushed and sheared.

Because of complex structure and lack of continuity of the beds no meaningful estimates of the resources in the field are believed possible without extensive subsurface exploration (Barnes, 1951, p. 11). Although a large amount of surface and underground prospecting has been done, no commercial mines have been developed. A major problem facing prospective developers of this field is transportation. As safe deep-water anchorage is lacking along the adjacent coast, construction of more than 50 miles of road or railroad to Cordova, the nearest deepwater port, might be necessary to get the coal to market.

Kootznahoo Inlet.—Tertiary rocks that locally contain coal underlie about 20 square miles on the north and south sides of Kootznahoo Inlet, on the west side of Admiralty Island about 60 miles south of Juneau. Coal prospects have been opened at several localities along the shores and on islands in the inlet (Wright, 1906, p. 153–154). At all these localities the coal beds are 2–3 feet thick and contain several shale partings. The only extensive development was at the Harkrader mine, where an inclined shaft was driven to a depth of several hundred feet. A small amount of coal from this mine was shipped to Juneau prior to 1929. Analyses of two samples from this mine (table 6) show the coal to be of bituminous rank, but the thinness and poor quality of the beds have discouraged further development.

THE ALASKAN COAL INDUSTRY

The first coal mine in Alaska—and probably the oldest on the Pacific coast of North America—was opened by the Russians in 1855, at Port Graham on the southwest tip of the Kenai Peninsula, but it was abandoned after about 10 years of operation (Martin, 1915, p. 107–108). In the period 1880–1915 coal mining was attempted or carried on for short periods at several localities, including Unga Island, Herendeen Bay, Chignik Bay, Kachemak Bay, and several points along the Yukon River. During this period the total annual production did not exceed a few hundred to a few thousand tons except in 1907, when a production of 10,000 tons was reported.

The era of sustained coal production in Alaska began with the completion of The Alaska Railroad to the Matanuska coal field in 1916 and to the Nenana field in 1918. As shown in figure 1, the annual production curve reflects a general rise from about 60,000 tons in 1920 to 174,000 tons in 1940, followed by a more rapid rise, during and after World War II, to 412,000 tons in 1950. In response to an increasing demand for fuel for power generation and heating at the rapidly expanding military bases near Anchorage and Fairbanks—which more than offset the decrease in demand resulting from a changeover from coal-burning to diesel locomotives by The Alaskan Railroad—the annual production more than doubled in the 3-year period ending in 1953, in which year a record production of 865,000 tons was attained. Following the peak in 1953, annual production to the end of 1964 fluctuated, for the most part, between 650,000 and 850,000 tons.

The total production to the end of 1964 was about 16.4 million tons, including about 9.6 million tons of subbituminous coal from the Nenana field and 6.5 million tons of bituminous coal from the Matanuska field. Small amounts of subbituminous coal have been produced from several other areas, including the Meade River district of northern Alaska, the Lignite Creek district of the Nenana field, the Costello Creek district of the Broad Pass field, the Little Susitna district of the Matanuska field, and the Homer district of the Kenai field.

Prior to 1925 a large part of the coal consumed in Alaska was imported from the States and from British Columbia—in fact prior to 1920, and again in 1925, imports exceeded production (fig. 1). As production increased, imports decreased and virtually ended by about 1945, when the productive capacity of the mines was able to keep pace with the increasing demand for coal.

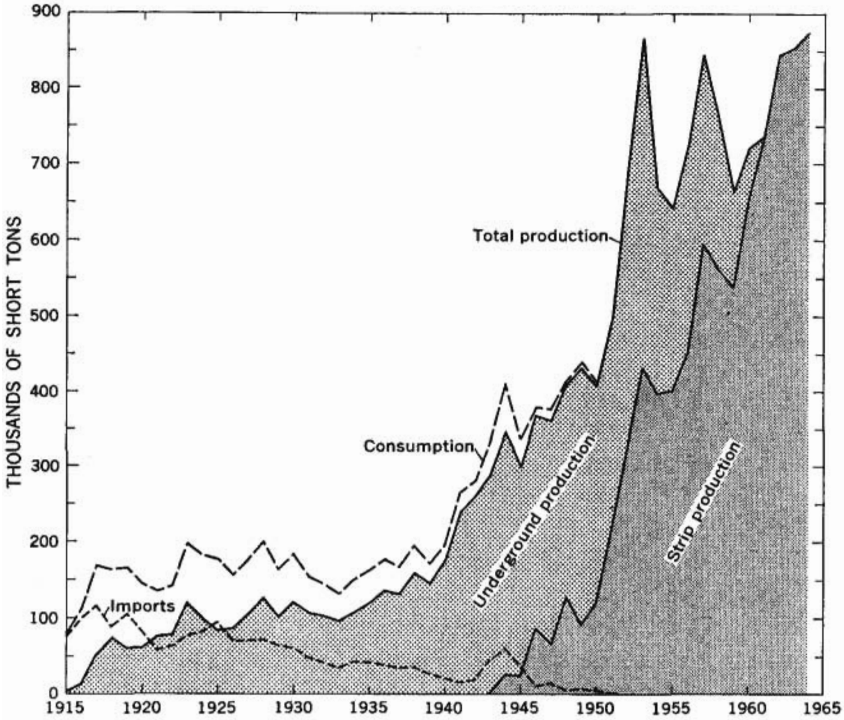

FIGURE 1—Coal production, imports, and consumption in Alaska, 1915–64.

Normally the annual consumption of coal in a given area may be assumed to equal production plus imports less exports, and because exports of coal from Alaska have been negligible, they may be disregarded. Thus the consumption curve in figure 1—which was constructed by adding imports and production—indicates that between 1917 and 1940 annual coal consumption in Alaska remained fairly constant, fluctuating between 100,000 and 200,000 tons; a general increase in production was offset by a decrease in imports. Although the above assumption is doubtless applicable over a long period, in Alaska annual production is not always an accurate measure of annual consumption because of a lag generated by stockpiling. Production depends largely on the size of military contracts, which, in years when unusually large stockpiles have been accumulated, may be for considerably less coal than it is anticipated will be needed; conversely, when stockpiles are low, as after an exceptionally rigorous winter, contracts may be for considerably more coal than is actually consumed, and consequently production is increased.

Prior to 1943 virtually all coal mining in Alaska was by underground methods. In that year a strip mine was opened on a thick but steeply dipping coal bed 4 miles southwest of Healy in the Nenana coal field, and in 1944 strip mining was started on similar beds on Healy Creek about 3 miles above Suntrana. A unique method of stripping coal was introduced in the Healy Creek operation that involved the use of hydraulic giants to both thaw and remove the permanently frozen overburden, which included a bed of massive but poorly indurated sandstone. Between 1949 and 1955 strip mines were opened at four other localities, including a second one on Healy Creek, one on Lignite Creek in the Nenana field, and at Houston and Knob Creek in the Matanuska field. By 1961 the last of the underground mines—the Suntrana mine on Healy Creek and the Premier and Evan Jones mines in the Wishbone Hill district of the Matanuska field—had been completely converted to stripping operations (fig. 1).

The future of the Alaskan coal-mining industry is dependent on several factors, the most important of which is the growth of industry and population of the State. The demand for heat and power will increase as growth continues. However, coal is now competing as an energy source with oil and gas from the rapidly growing Alaskan petroleum industry, and to some extent with hydroelectric power. The proportion of the market that coal will retain will depend largely on the relative costs of the competing sources of energy. One method of improving the competitive position of coal is to build large thermal powerplants at or near the mines. Electric power could be transmitted to the principal consumer areas, thereby eliminating the considerable cost of transporting the coal. Such plants are now in the planning or early construction stage at Sutton, in the Matanuska field, and at Healy, in the Nenana field (Alaska Div. Mines and Minerals, 1964, p. 12).

Also of possible great importance to the future of the Alaskan coal industry is the fact that the greater part of the most accessible coal reserves—particularly in the Nenana, Susitna, and Kenai fields—consists of subbituminous coal and lignite, which is of potential value for uses other than heat and power generation. Although research into the chemistry of these lower rank coals is still in an early stage of development, it is already known that they are valuable raw materials for the manufacture of a wide variety of chemical products as well as synthetic fuels. As continued research and technological advances increase the number and decrease the cost of making such products, new industries may well be drawn to Alaska to tap these large resources of low-rank coals.

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